Accelerator Systems Division Highlights for the Week Ending May 3, 2002

ASD/LBNL: Front End Systems

The 2-MHz amplifier serving the Ion Source was definitively repaired by 4/30, and beam tests resumed but were initially hampered by various problems with operating the emittance device and other diagnostics elements. By mid-5/3 these problems were resolved to a degree that meaningful measurements could be taken again. Sasha Aleksandrov had returned to participate in these activities.

The polarity of the bias voltage on the wire scanners was reversed, and the result of a full voltage scan is that a positive bias (impeding secondary electrons from leaving the wire) is clearly the best way of operation and produces meaningful results.

The MEBT rebunchers were operated with beam at full nominal power, and for the first time, credible vertical emittances of a bunched MEBT beam were measured.

Martin Stockli visited to observe operations and discuss hand-over details and operational issues for Ion Source and LEBT with FES staff.

We are now preparing for the last stages of FES commissioning, notably the demonstration of full beam current and of full duty-factor operation and the performance of a 24x5 endurance test.

On May 2, the SNS Front-End Systems had a day of celebration with about 100 invited guests, in view of the upcoming hand-over of the hardware to SNS-ASD. Thom Mason, Carl Strawbridge, and Norbert Holtkamp participated in this event, together with LBNL director Charles Shank, AFR Division director Bill Barletta, and two representatives of the University of California.

ASD/LANL: Warm Linac

The second 402.5-MHz klystron arrived safely at LANL (Fig. 1). (WBS 1.4.1.1)

The first Marconi klystron continues to be tested at LANL. This week it operated at 1.7 MW output RF power, 130-kV, 60 Hz, and 1.38 ms pulsewidth, 39-Ampere beam. The 96-hour (not continuous) site acceptance test is underway. After running six hours on May 3, we have had a few set-point trips, but otherwise no significant anomalies. (WBS 1.4.1.1)

The first article 5-MW 805-MHz transmitter arrived at LANL (Fig. 1). Installation is underway. (WBS 1.4.1.1)

Recent changes to the prototype high-voltage converter modulator (HVCM) IGBT gate drive continue to enable higher power operation. We have run the Marconi klystron routinely at 130-kV, 5-MW HVCM output pulsed power, and 400-kW output average power. IGBT and oil tank losses were measured, and preliminary result indicate that the converter efficiency at 500 kW (60 Hz) average would be around 92%. It appears that our increasing the gate drive enabled the success, confirming our electrical observations, modeling, and observed heat losses. We are still modeling the system (and gate drive requirement) to determine the dI/dT versus tube load and transformer coupling "k". The diagnostics are a noisy, and need improvement. The Mitsubishi engineers are going to bring their various diagnostic equipments next week to make on-board measurements of the system during operation. Mitsubishi engineers do not think there is any problem with the 20 kHz and they have different internal IGBT architecture for higher current and frequency, but at a cost of latch-up sensitivity and fault mitigation. (WBS 1.4.1.2)

We are making progress on the DTL Tank 3 alignment measurements. Consultation with the Leica and ASD had led to laser tracker tests, and further alignment measurements. ASD personnel are coming out to work with us this over the weekend to resolve whether we have an alignment or a measurement issue. (WBS 1.4.2.7)

Fig. 1: Simultaneous delivery to LANL of the second transmitter from Titan (upper semi) and the second klystron from Marconi (lower semi)

The physics team is working towards the completing studies on the timing and efficacy of the LEBT and MEBT choppers. Fig. 1 shows the y-y' projection of beams emerging from the RFQ. The blue points correspond to beams in which the LEBT chopper voltage set to 50% of its full design value. Since the beam is deflected in 4 different directions by the LEBT chopper, each output beam is different. The effective emittance is defined as the superposition of all four output beams since we won't know which emerges for what voltage. The pink data represents the nominal unchopped beam. The chopped beam has an effective emittance ~2.75 times larger than the nominal beam. The effective current of the chopped beam (average of the 4 beams at 50% voltage) has been reduced to 30% of the injected value. During the voltage ramp some of the beam gets past the MEBT chopper. In the case where the MEBT chopper is already on about 6% of the beam gets past for 50% voltage on the LEFT chopper. We are now studying how much beam current this amounts to as a function of voltage and where it goes in the linac. (WBS 1.4.5.3)

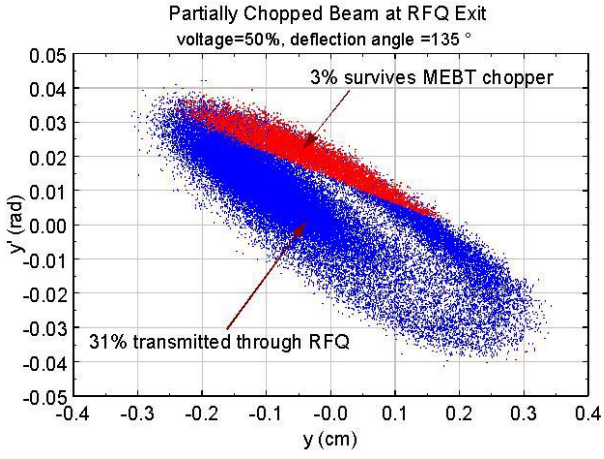


Fig. 2: Phase space projections of partially beams emerging from the RFQ

LANL submitted PCR LI 02 025, which involves the transfer of the procurement responsibility of the DTL and CCL water-cooling system transfer lines from LANL to ORNL. LANL will complete all engineering of these water transfer lines including component specification, pressure drop calculations, and material selection, but will leave the responsibility of procurement, installation, and generation of as-built drawings up to ORNL. This revised design/procurement approach will save the SNS project considerable labor costs as well as hardware costs. (WBS 1.4.6.1)

ASD/JLAB: Cold Linac

Motor torque data for the first cold compressor test has been received from Air Liquide for review. The gas management skid was shipped to ORNL.

Installation of the prototype cryomodule into the test cave continues. The unit has been installed on the stands and finally aligned. Initial fitup of the U-tubes revealed an interference with fire sprinkler piping and the J-T valve. Both interferences have been corrected. The readiness review for initial cooldown is nearly complete, and cooldown is now scheduled for the week of May 13.

ASD/BNL: Ring

T. Mann and G. Murdoch were at BNL this week to review equipment deliveries for Ring system components.

J. Gioia (LANL) was at BNL this week to assist R. Lambiase with the testing of Danfysik's low field power supplies.

HEBT "Y" box vacuum chambers: the four chambers received from our vendor have been inspected at BNL and shipped to SNS/OR.

The 1st article turbo pump station has arrived at BNL and is undergoing acceptance testing.

Dipole shimming status: 13 of 16 have been shimmed and tested.

The first four production octupole corrector magnets arrived from NE Techni-Coil. Setup for acceptance testing is underway.

BINP: 3 coils wound, one vacuum impregnated, and one in winder. The core machining is about 50% complete. Will ship to BNL by 6/1.

The 16CD20 magnet was approved for production by ASD.

ASD approved the specification for the Ring dipole power supply. An RFQ will be released by BNL Contracts in early May.

Testing of the anode PS for the Ring RF system is underway.

W. Eng was at IE Power last week to conduct acceptance tests on the 1st article injection kicker power supply. Unfortunately, problems remain with low voltage regulation and ripple. More work by vendor is required.

We are happy to welcome Ms. X. Geng and Yuri Eidelman (two new Guest Appointments from the Oak Ridge Project Office) who are working with our Controls Group under the direction of Larry Hoff and John Smith.

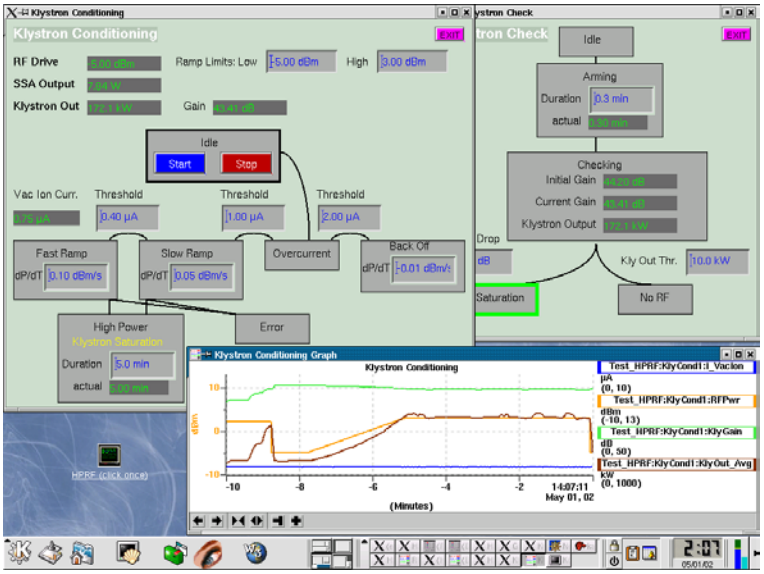
Controls

Johnny Tang joined the SNS/ORNL Team this week. He will continue work on the timing system, and prepare to accept and maintain all vacuum control systems. Three team members attended EPICS classes at Los Alamos. Eric Bjorklund visited LANL to assist with the installation of the timing system there, and Derrick Williams visited Los Alamos to prepare for installation of soon-to-be-delivered DTL systems.

At Berkeley the timing system has been implemented and is in use for the MEBT runs. Six consoles with 11 monitors are now in use and more would be handy. Our hope at ORNL is to run the entire warm linac with three consoles and 12 monitors! Operational improvements are made daily, including to the Matlab/CA library and the emittance application. The EPICS Archiver has been implemented and 60Gb hard drive added for accumulating MEBT run data.

Effort continues on preparations for DTL installation. A spreadsheet for Front End MPS inputs was prepared which details the inputs and the rack location assigned to each MPS chassis channel and the location of that chassis. The first cut for the DTL MPS inputs is completed. The DTL Resonance Control Cooling System rack and drawings are complete, and a Design Criteria Document for the DTL controls is completed and under review.

At LANL, a Power Supply IOC is now running with its drivers (from BNL). The automated Klystron conditioning Drive Ramp was used to ramp the klystron from -5 to 3dBm RF drive, watch the Klystron Gain & Output, detect "Saturation" just before reaching 3dBm and then hold "High Power" for 5min. A montage of control screens used for this application is shown below:



PPS Phase 0 control racks have been set up in the RATS building. PLC programs are being generated and testing is underway. As built design drawings have been received from the vendor and have been issued through SNS

document control. Cabling for PPS Phase 0 Front End equipment has been ordered, and an SRO for installation of the Phase 0 PPS equipment has been generated. Miscellaneous equipment drawings have been issued and some components have been received.

An environmental test chamber has been received and set up in RATS for Chipmunk testing. The first temperature cycling test of a prototype Chipmunk revealed that the output fluctuations during this testing were still present after modifications were made to improve performance. Most testing will be performed to try to isolate the source of the problem

A plan was presented for installation of a high frequency ground in Controls and Diagnostics racks and for systems with low-level signals and those susceptible to high frequency noise in the grounding system.

An upgrade to the FELK design package for CF Controls was issued CFC. This upgrade includes information (such as cables listed in the commodities contract) that was not available when it was first issued CFC. Most of the CF controls work in the FE building is finished and went smoothly.

All EPICS programs ("C" Code) are managed and controlled under the Concurrent Version System (CVS) repository at SNS/ORNL. This week, this was extended to include the Altera Field Programmable Gate Array (FPGA) code that is used for the intelligent Machine Protection System (MPS), Timing System and Low Level RF System. Tested on the MPS Altera Code, the total compile time was not much more using the CVS directory than using a local hard drive. This was a very important step forward, and will allow configuration management of all Programmable Logic devices (PLDs) using the same tools and protocols as for the EPICS software. PLC software can be managed in the same way.

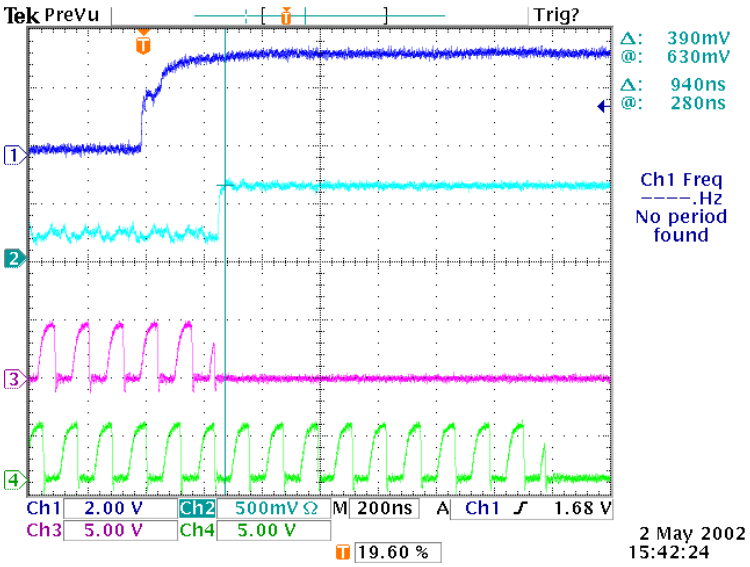
Testing of the SNS controls for the warm compressors and gas management system was completed in the RATS Building. This testing validated operation of the cryogenic control system from the PHPK PLCs through the SNS PLC via ControlNet the EPICS IOC, the EPICS operator interface screens, the SNS EPICS application development environment and the SNS software version control system (CVS). We successfully controlled devices on the PHPK skids in the RATS building from our offices at 701 Scarboro Rd.

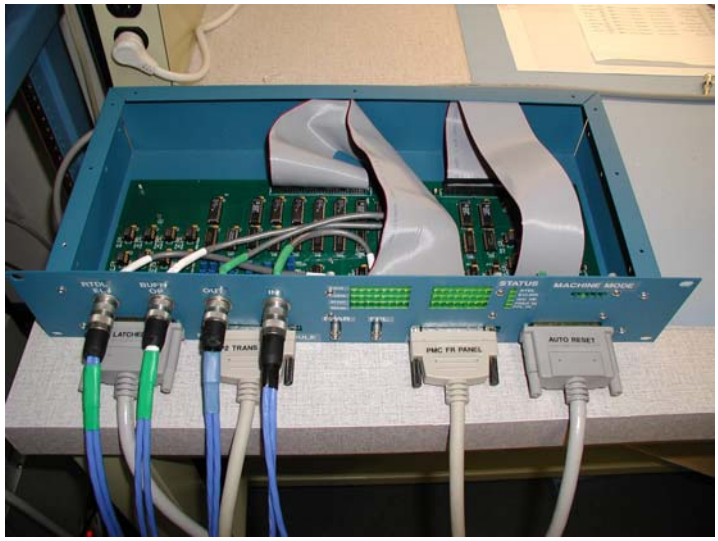
MPS systems were shipped to Los Alamos and Brookhaven for compatibility testing with miscellaneous typical VME hardware. Noise susceptibility testing will also be performed in Los Alamos, using the transmitter power supply. Three MPS systems were successfully connected in a typical carrier chain configuration with 250' cable between systems. The cable and fault delay, from input fault to output fault status and carrier dropping were measured to be around 1.6 usec, well within specifications. This significant achievement is illustrated in the scope traces below, in which:

Trace 1 is the output from test module, simulating a fault;
Trace 2 is the MPS status from chassis 1 (this will turn off the beam)
Trace 3 is the MPS chassis 1 carrier clock output; and
Trace 4 is the MPS chassis 3-carrier clock output

The first frame shows an "Auto Reset" fault, for which the beam will be enabled for the next macropulse. The second frame shows a "latched" fault, which must be manually reset before beam is enabled. Note the different time scales. These two systems operate with different carrier frequencies. The difference in fault propagation delays is due in part to the different time constants used to declare a fault. A programmable debounce circuit is used to minimize false trips detected due to noise pickup in the copper carrier signals. There is 250 ft of cable between chassis 1 and 2 and between 2 and 3. The propagation delay of the cable is 1.46 nsec/ft. Beauty, eh??

The actual MPS chassis is shown below the scope traces.





Installation

Accelerator Physics

S. Kim has performed an analysis of the thermal stability of the FPC transition piece of the superconducting cavities to understand the limit on RRR that is tolerable from a thermal standpoint. He finds that the thermal stability is very sensitive to RRR, and those values greater than 50 are acceptable. Apparently, the RRR of this reactor-grade niobium degrades after annealing to a value near 20, which in light of this analysis, is not acceptable.

The applications programming group has been testing programs remotely with real MEBT data. The orbit difference application was run remotely and trajectory response to correctors was measured.

J. Stovall and LANL collaborators have been continuing studies of the fate of partially chopped bunches. They have studied the transmission of partially chopped LEBT beam through the MEBT with the MEBT chopper at full amplitude. They find that the highest transmission results when the LEBT chopper is at about 50% amplitude. In this case, only 1.7% of the partially chopped beam makes it to DTL tank 1. Studies continue to evaluate beam loss in the linac from this small partially chopped beam.

The ORNL and BNL ring/RTBT fault studies participants met with the target group and Coles Sibley to discuss fault studies results and plan for detecting fault conditions. The fault studies show that in order to violate target requirements on maximum current density and beam power within the nominal spot-size, gross errors are required. These gross errors typically result in huge beam loss upstream in the RTBT or Ring. The protection strategy therefore relies on beam-loss monitors in the MPS system, and current monitoring of the last few RTBT quadrupoles.

A commissioning videoconference was held with LANL, focusing on DTL tank 1. In order to run the DTL tank 1 with D-plate at the full average power the beam stop is capable of handling (11.7 kW), shielding is needed around the beamstop to avoid activation of beam line elements (in particular tank 1). This issue has been studied by Franz Gallmeier and his conclusion is that enclosing this beam stop using a borated polyethylene block with about 20-30 cm thickness at all sides very efficiently suppresses the neutron field in the concrete bunker, and therefore reduces the anticipated activation of the DTL tank #1 components and the concrete walls. The heating rates in the PE block are so low that cooling of the PE block is of no concern. The impact of the new IPS on DTL tank 1 commissioning was also discussed.

Operations Group

Continued work on the Draft Readiness Plan of Action

Continued work on the Draft Commissioning Program Plan

Added DESY experience to SNS RAMI

Developed a revised Spares List with Project Office guidance.

Participated in PPS Equipment Review and Approval.

Helped develop ASD Work Smarts Standards.

Worked with the SNS Management Information Systems (Oracle Based) - Electronic Traveler.
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Worked with ORNL Telecommunications on Cell phones tower strategy on the SNS site.

Continued developing Operations Procedures and Training for PPS Search, Front End Operation, and DTL Tank 3.

Ion Source Group

Paul Gibson generated an AC checkout procedure for the Big Blue Box.

Robert Welton has mapped the ion source plasma by measuring the emitted light with a spectrometer as a function of hydrogen gas pressure and RF power. The power of the 13.56 MHz amplifier was varied up to 500 W continuous.

The repaired QEI 80-kW, 2-MHz RF amplifier was received in apparently good condition. We expect to test in the next few days.

Robert Welton has modified the emittance analysis software to allow for determining the background bias current within an elliptical ring. This became necessary after it was discovered that the bias current could increase with the distance from the beam center. Emittance estimates with rings were found to be approximately 10% higher than previous estimates.

Martin Stockli visited LBNL to attend and assist commissioning at LBNL. In this process we received essential information on the LEBT chopper supplies and other subsystems. Most important was seeing the QEI RF amplifier problems first-hand. We will duplicate LBNL's corrective action in removing the resistive divider that arced and

adding parts to suppress the parasitic oscillations in the GHz range. We will work with QEI to find and implement improved engineering solutions to prevent future arcing in the output inductance.

RF Group

Brian gross & chip Piller will help with the front-end take down.

Hengjie & Taylor will be at LANL next week to check LLRF CDM module, revision 2 and work with the High Power Protect Module.

Mark will be at Jlab from the 13 to the 24th for prototype cryo testing.

Jeff Ball returns Monday the 6th.

Marion & Mark are reorganizing the SRF facility.

Yoon and Craig are working on DTL tuning, getting ready for tuning at ORNL.
Group is working on procedures, acquiring documentation, etc.

Waveguide installation starts the 6th, Ray Servino a month's workload of assemblies ready for installation.

Mechanical Group

Finalized details and pricing of RGA based leak test pump carts needed for leak testing of the CHL and cryolines and prepared an equipment procurement justification memo to cover this out of scope procurement.

Conducted vacuum system familiarization with Johnny Tang of the Controls Group who is assigned as vacuum controls interface engineer.

Completed acceptance testing of 31 ion pumps and prepared the pumps for storage. Shipment to storage is scheduled for next week.

Support was provided to the Cryo Group in leak testing of the buss bars currently being fabricated.
Performed initial leak testing of the beam dump flight tube to meet the advanced delivery schedule. This consisted of leak tests of the embedment assembly, the root pass weld of the flight tube extension, and the root pass weld joining the flight tube extension to embedment assembly. A cold shock test of the root passes was also performed and the complete assembly re-leak tested. Final welding and leak testing of the completed flight tube is scheduled for next week.

Accelerator equipment received this week included four ion pumps, and one TMP for the DTL/ CCL installation. The receipt of this TMP corrects an earlier mistake by the vendor in the actual quantity shipped.

Cryogenics Group

HL: The steel is set from column lines 1-7

Transfer lines: Work continues on the high beta supply modules and the medium beta return modules.

Beam dump flight tubes: The inner vacuum pipe has been welded on the linac beam dump, and is currently undergoing vacuum certification.

Personnel: We continue interviewing for the open technical positions for the JLAB cryomodule work.

Electrical Systems Group

The first of 10 water-cooled, underground buss assemblies was constructed and tested at the RATS building. These are the power feeds from the ring service building to the ring enclosure for high-current magnets.

Survey and Alignment Group

Beam Diagnostics